

ADELAIDE PHILOSOPHICAL SOCIETY.

PAPER READ NOVEMBER 15, 1864, BY THE HON. SAMUEL DAVENPORT.

Subject--"The Extraction of Scents from Plants."

"Since the cultivation and development of our faculties is both an aim and sign of civilization, it may be admitted to the sense of smelling to have some claim on our attention. It is said that its cultivation, like that of other senses, augments its powers, and that persons given to the due use of perfumes have the faculty of smelling rendered more acute. Perfumes are donations from the vegetable kingdom chiefly. They constitute a store, given by Providence to the charge of plants, whence man may be supplied with refreshment and health, obtainable through the medium of the organs of smell or taste. The perfumes of plants are antiseptic, stimulating, disinfecting midst vitiated atmospheres, often tonic, and as gratefully invigorating the sensations of life as the beauty of many flowers and plants producing them is pleasing to the eye. They constitute the special attraction of perfumery--bouquets and nosegays, smelling-salts and vinegars, sachet-powders and incense, scented soaps, pomades, and oils, &c., as well as of numerous liqueurs and the most *recherché* confections. Thus they also possess a commercial value.

"The ancient pagan world acknowledged the relative eminence of their regard for perfumes by the offer of costly incense to the gods of their temples; and on the dawn of Christianity the same medium of reverence for Deity is traceable in the offering to the infant Saviour of gold, frankincense, and myrrh. Subsequently, through various phases of human existence, perfumes have entered into exhibitions of devotion, be it in the temple service or the social feast, the pomp of royalty, or the quiet luxury of private life. In England, according to the author of the 'Lives of the Queens of England,' perfumes were never richer, more elaborate, more costly, or more delicate than in the reign of Queen Elizabeth. She had a cloak of perfumed Spanish leather, and in her days perfumed gloves and shoes were fashionable. Whilst at Hawkstead, among the rooms on the ground floor was one called the 'stillroom,' where ladies of the Court amused themselves in distilling fragrant waters; and the ladies of the wealthy classes generally in those days took lessons in the art of preparing perfumes and washes. But to take the world of the present day, and its demands for perfumes of plants, some of the fairest spots of Europe and Asia are devoted to their cultivation; and the question brought home to us is whether this, our own sunny soil of South Australia, should not join competitor with these other fair spots of their production, nor leave the fine fragrance of its flowers to be longer wasted on the wandering air. Great Britain pays annually to foreigners for perfumes half a million of money, because none of her own colonies as yet supply her wants.

"The perfume or aroma of plants resides in their essential or volatile oils. These oils exist in various parts of plants. Sometimes they are distributed throughout the plant, as in the Angelica, often in the leaves and branches, as in balm, mint, and wormwood (absinthe). The Florence Iris and ginger retain their essential oils in the root only; whilst lavender, thyme, rosemary, and verberna have theirs in the leaves; the rose, the jasmine, the heliotrope, the citron, and orange in the flower; and the last two also in the leaves and skin of the fruit. Aniseed and fennel contain their oil in small vessels ranged along the salient lines observable on the outer bark. Other plants carry their oil in the bark itself, as cinnamon; in the substance of the wood, as sandalwood and myall; in the seed, as coriander and caraway.

"Essential oils are distinguishable from fatty and other oils by their volatility and by their property of not leaving spots on paper. They have an acrid or burning taste, and are colourless or variously coloured--as yellow, red, brown, green, or blue. They are lighter than water, excepting the oils of cinnamon, cloves, sassafras, and mustard. They are generally fluid, and evaporate in the air at its ordinary temperature, and more readily under heat; but all can be solidified by reduction of temperature, and some--as the otto or essential oil of roses--readily congeal. They ignite when in contact with fire, and burn with a clear flame, but much smoke. Distilled pure, many of them decompose; but with water added in distillation, their properties remain unchanged. Though coloured when extracted, exposure to the air darkens them through the absorption of oxygen. Light assists this change; and, under the joint influence of light and air, the oil thickens, loses its odour, and grows resinous. Therefore, to preserve essential oils they should be enclosed in glass-stoppered bottles, perfectly filled, and kept in a dark chamber, or covered with black paper. These essential oils are slightly soluble in water, readily so in alcohol, the more so it is concentrated, whilst ether dissolves all essential oils. They combine with certain acids, as acetic and oxalic acids, and they dissolve in resins and animal fats. Essential oils are much used for medicines, for perfumery, and for varnishes, because of their properties of dissolving colours, and their rapid evaporation on being applied.

"The maximum of oil, both in quantity and quality, is yielded when the parts of the plant containing them arrive at full maturity. Thus roots yield best at the end of spring; leaves and branches when the flower is on the point of development; the flower at the moment of its full expansion; and the fruit when first ripe. The most of plants, and especially flowers, give off essential oil only when fresh; some will preserve their oil for years uninjured, as the milfoil and balsam, which yield oil only when dry. The quantity of oil for extraction from plants varies with the kind, the climate, soil, exposure, freshness, or dryness. In general, those plants which grow spontaneously on arid soils, hilly and exposed to the sun, furnish the most volatile oil, especially from the flowers when they first expand, and if distilled as soon as gathered.

"The extraction of perfumes, scents, or the essential oil of plants is accomplished in one of the following ways:--First, and the most natural, by expression. With your hand you squeeze the fresh peel of an orange against a burning candle, and the jets of essential oil emitted ignite with a species of explosion on contact with the flame. By like squeeze you may eject it into a sponge till that is saturated with the essential oil of orange-peel, known in commerce under the name of 'Eau de Portugal'--Portugal water. Of course, however, in a manufactory of scents, machinery is substituted for the fingers, and the peel is subjected to a strong screw, or hydraulic press, acting on a cylinder furnished with a false bottom perforated with holes, through which the expressed oil falls, and is gathered by means of an orifice made at the base of the cylinder; but here only that substance of the peel is taken in which the small vesicles containing the oil lie, and hence the epiderm, or true outside rind, is pared or grated off from the white and interior stratum of the peel, and the pulp of this alone is submitted to the press. In Italy, Portugal, and Provence, the pulp thus resulting is expressed between two glasses slightly inclined.

The produce, after resting awhile, deposits a little parenchyme or fle-hy fibre, from which, when filtered through paper, the oil is passed into a well-stoppered bottle.

"But this and other essential oils are obtained also by the process of distillation, the chief of all extracting processes. Two classes of products result from distillation--the oil or scent pure, and the water saturated with the oil, called distilled water. But, first of the oils. When the parts of odoriferous plants are distilled with water, the oil passes over along with the steam, and separates itself in a great degree when condensed in the receiver. The distilling apparatus used resembles that employed for converting wine into brandy, excepting that the still is higher and presents a lesser surface to the fire. The head and worm of the still are often of tin, and the still tin-lined, in order to avoid imparting a coppery odour to the products. The process of distilling is as follows:--

The plants, or parts of plants, are placed in the boiler. Water is then added, the head put on, the worm attached, and the receiver put in place. The joints are then luted and the fire lighted. As the steam of the boiling water rises, the essential oils, also set at liberty by the same heat, pass through the head into the worm, where, condensing under the cooler temperature, they jointly flow out in a limpid state into the receiver. Soon that water is troubled, becoming milky by the separation from it of the oily particles, which, being lighter than the water, mount to the surface, and there form a bed increasing in thickness as the distillation proceeds, and which, drawn off, is the oil in a state of purity. A writer in the 'Maison Rustique' says that in the South of France, where the greater part of the essential oils of commerce are prepared, the makers of them, in the month of July, transport their stills to the localities where a sufficient quantity of aromatic plants exists, and set them up in the open air, as near as possible to a running stream. By means of four stones they construct a furnace, and announce their demands for this or that plant. The inhabitants of the neighbourhood arrive, agree upon the price to be paid them for their plants, which, being gathered and distilled, the manufacturers move on to repeat the process elsewhere.

"The quantity of water which should be added to a plant in the still varies according to the kind of plant and the amount of oil that plant is capable of yielding. If too much water be used, the essential oil being to a certain degree soluble in water, less oil is obtained, and the product is only water saturated with oil. On the other hand, if too small a quantity of water be used, the plant will adhere to the bottom of the boiler, and give a burnt flavour, materially altering the quality of the oil produced. Experience alone must guide the manufacturer; but it is well rather to exceed than to be too sparing of the quantity of water used. The water in the receiver may be again employed in the still, so that the oil it holds in solution be thus less subjected to loss.

"To procure the best quality of oil the first formed is drawn off from the receiver before the process of distillation is complete, the first formed being the strongest and most agreeable odour. Some oils being less volatile than others, and therefore passing off less readily under distillation, are aided by the addition of salt to the water used in the still, the effect being to augment its density, and to require a higher degree of heat for the volatilization of the oil. The water of the cooler generally separates more oil when it is kept at a

low temperature; but as some oils are solid at a low temperature it is necessary in their cases to avoid reducing the water of the cooler to a less degree than 45° to 50° Fahrenheit, or the oil will remain solidified in the worm. Of this class is the oil or -to of roses. The fire should be kept at a moderate and regular heat, not subjected to great alterations, as when forced by bellows or drafts of air, first exciting to greater life, then relaxing its vigour; for extreme alterations of heat applied tend to burn the plant and to decompose them, to the injury of their production of oil.

"You cease to distil when the product becomes insipid and inodorous. The receiver in common use in the extraction of essential oils in the South of Europe is the Florence receiver (recipient florentin), a kind of flask, having a tube rising from its base, curved like the letter S. Here is a specimen. During the distillation the mixture of oil and water runs into this receiver, where they rapidly separate, as stated above. The oil floats on the top, and when the height of the mixed liquids rises to the upper opening of the S tube the water runs from this orifice, so that the level of the liquids in the receiver is always the same. The layer of oil increases from time to time, and may be drawn off from the water as necessary. The distillation ended, the mixture of oil and water is emptied into a glass funnel with a fine neck, which may be stopped with the finger till the liquids separate, and thus the water let off, leaving the oil alone in the funnel; or the oil is taken up by means of an instrument called 'pipette,' of which I also present a specimen. The oil is then bottled and hermetically sealed. This Florentine receiver is used only where the oils are lighter than water. Those that are heavier are received in cylindrical vases, whence the liquids are separated by use of the funnel, or by means of a tap.

"The following rules for the distillation of essential oils are given by De Fontenelle, a French chemist:—1st. To obtain quantity and quality, operate on a sufficient mass of plants. 2nd. Distil rapidly. 3rd. Cut in pieces the substances for the still, so as to facilitate the yield of the oil they embody. 4th. Employ no more water than is necessary to prevent the plant burning. 5th. For exotic substances, of which the oil is heavier than water, add salt to the contents of the still, whose increased density demands a higher temperature to produce boiling. 6th. For indigenous plants, redistil several times the same water on new substances of the same nature, thereby to more fully saturate it with the same oil. 7th. For oils naturally fluid often refresh the water of the worm; but keep it at 45° to 50° for the oils which concrete easily, as those of aniseed and roses. The quantity of oil annually yielded is relative to seasons more or less wet, more or less warm, the nature of soil, its exposure, and the maturity of the plants.

"The practice of distilling essential oils may receive further illustration by the following examples:—

"1. Thus, to extract the scent or essential oil of orange flowers, gather them when dry in early day after the dew is off and before the noon heat, remembering that those flowers just fully expanded contain the most oil. As soon as possible after the flowers have been picked place them in water, soak them in it for 24 hours, then distil. The proportion of water should be about a quart to every 2 lbs. weight of flower. The product will be oil, and water scented with the oil. The oil is called 'Neroli,' and is worth £28 the quart. The water should be distilled again on fresh orange flowers to produce more oil, and eventually also that useful tonic and antiseptic—orange flower water. The scent of 'Neroli,' as of the orange flower water, is that of the orange flower itself. But if you distil orange leaves they yield a scent of quite a different character, one of the lemon class, and called 'Petit grain.'

"2. Oil of Rose.—This oil, or otto of roses, is specially prepared in Turkey and Persia, by distillation, from the rose pale (Rosa centifolia—cabbage rose), and the Damascus rose (Rosa semperflorens), which grow more odoriferous in those countries than in Western Europe, and hence the oils they yield have a special value. The otto is obtained by distilling many times the same water on rose leaves to which salt has been added. Thus, they take—say of rose leaves freshly gathered 60 lbs.; of common water 11 quarts; of salt 1 lb., and distil until no more volatile oil comes off. This oil is soluble in water, to which it communicates its odour, and

constitutes rosewater, triple, double, or simple, according to the quantity of oil with which it is charged. In Europe the Rosa gallica, or Rose de Provins, is chiefly used. Note, in passing, that five kinds of roses appear to be cultivated for scents:—1. Rosa centifolia (cabbage or Provence rose), above 100 varieties (of which are our moss roses), from Caucasus; all cabbage-head, slender footstalk, drooping and graceful. 2. Rosa gallica (Provins rose, native to Europe), grown largely near Provins, a town in Seine-et-Marne (the druggists use this for making conserve of roses), above 100 varieties; a compact erect-growing plant, with large, open, flat flowers on stiff, upright stalks—the architectural rose. 3. Rosa damascena (Damascus or semperflorens) differs from centifolia in the large size of its prickles, the greenness of its bark, its elongated fruit, and long reflexed sepals, above 100 varieties. 4. Rosa moschata (Muscate rose), 10 or 12 kinds; slender branches, require support, never want pruning, flowers only at extremity of shoots. 5. Rosa sempervirens (evergreen rose); this rose furnishes the famous essence of rose of Tunis.

"3. Oil of Peppermint.—Made by distilling the plants in water, and redistilling that water in fresh plants. The mint is best taken at the moment of its flowering, and the soil chosen for its cultivation should be well exposed to the sun. Before distillation the mint is stripped of its branches, and left for a day infused in water. The oil of mint has a greenish colour, and is soluble in alcohol and in water. The first solution is called 'Essence of Mint,' and the second 'Mint Water,' of which great use is made in medicine as a cordial, vermifuge, &c.

"4. Oil of Lavender.—Lavandula spica (or aspic of Provence, Roussillon, Languedoc); and Lavandula vera (garden lavender).—Obtained by the distillation of the flowers as per practice with orange flowers, also by infusion of flowers in alcohol.

"The above are pure products of distillation, the extraction of unmixed scents—scents in themselves valuable, but specially so as forming the material out of which many delicate perfumes are subsequently prepared; for scents blended form new compounds—some harmoniously, and others to neutralize and destroy. Piesse classifies them as the notes of music, and in the best of perfumery the skilful blending of pure scents is a matter of interesting study. Thus eau de cologne owes its excellence, and as a commercial speculation has brought wealth to its manufacturers and their country, through a great success in the blending of scents. Three species of plants produce it, viz., the vine, the orange tree, and rosemary. Piesse states that the first quality of eau de cologne is produced of the following ingredients:—Spirit, from grapes, 60° over proof, 6 galls.; otto of neroli, pétale, 3 ozs.; do. do. bigarade (Seville orange), 1 oz.; do. rosemary, 2 ozs.; do. orange zeste (peel), 5 ozs.; do. citron peel, 5 ozs.; do. bergamot, 2 ozs.; mixed with agitation, then allowed to stand a few days perfectly quiet before bottling.

"Of Distilled Waters.—Distilled or aromatic waters, as disseminated in commerce, are preparations composed of water having an essential oil held in solution. These waters, used in perfumery, in medicine, and in domestic economy, are prepared by means quite identical with those employed in obtaining essential oils, excepting that a greater quantity of water is used in their distillation, and that a more vigorous and lively fire can be used to give off in a stated time a greater quantity of watery vapour. The essential oil is thus prevented separating itself so readily from the water, which retains a greater proportion of it in solution. The waters of anis, peppermint, coriander, fennel, absinthe, thyme, &c., are prepared thus—by taking one part in weight of the plant and four parts of water, and distilling thence a produce equal to two parts only. The waters of rose, lime-tree (lillean), &c., by taking one part of plants to two parts of water distilled to a produce of one part. The waters of orange flower, double, one part of flower to three of water distilled to two parts; or if only a half of this produce be obtained, viz., one part, it is then called orange-water quadruple. For Distilled Waters.—The rules laid down by Chevalier are—1. If the substance to be distilled has a close texture, or contains little water of vegetation, it should be broken up small, grated, or divided into morsels, and left some time in water, to allow the vegetable fibres to become well saturated, and so facilitate the exit of the volatile principles. 2. If the plant is comparatively inodorous, redistil the product of the first distilla-

tion on fresh plants as often as desired. 3. If the plant be highly odorous, put enough in the still to saturate the water sufficiently at one distillation. 4. Take care that enough of water is in the still to cover the plants till the distillation is over. The more the plant is succulent the less it needs of water. 5. Where it is apprehended the plants will soften by their boiling, so as to form a paste at the bottom of the still, support them by means of a wicker false bottom, or a metal diaphragm, or a bed of straw. 6. Bring the water rapidly to the boil, and sustain the boiling to the end. 7. Cool the worm as often as possible. 8. Use fresh plants in preference to dry, excepting balm, which gains odour in drying. 9. Filter the aromatic waters after their distillation, so as to separate any drops of volatile oil which may often be in suspension, and render the waters dangerous for use. Immediately after distillation these aromatic waters have a taste of the acid and disagreeable, which passes off in a little time; also often, after some days, flakes of mucilage are formed, which rest in suspension in the fluid or are precipitated, and give a disagreeable taste to it. If this happen the waters should be redistilled, preserved in glass or crockery vases, and filtered to take off the mucilage. Never cover these vases with linen, but with paper, as under the linen a mouldy taste will arise. For example, to obtain—

"Peppermint Water.—Take clean fresh leaves and flowers of peppermint, one part; water, four parts; and after 24 hours of maceration (soaking) distil to a product of half the water employed. If it is desired to intensify the product, redistil on fresh plants. Should there be a great quantity of plants to distil, take out the mint already distilled with a skimmer, and add new plants to the liquid left there, which being in a boiling state will much shorten the second distillation. In a like manner are obtained the waters of wormwood (absinthe), hyssop, marjoram, balm, rue, sage, thyme, &c.

"Orange-Flower Water.—Bring the water in the still near to boiling point; place the flowers in, and stir well; put on the still-head and distil. If you run off 1,000 grammes of produce for each 1,000 grammes of flowers, the product is called 'orange-flower water double'; if 1,500 grammes for 1,000 grammes flowers, 'treble.' The distillers of Grasse prepare another kind of water of orange-flower with the flower-stalks and fresh leaves, to which they add 4 grammes of neroli for each 51 kil. of water. Thus obtained, the water is more bitter and less fragrant, but is cordial, stomachic, and vermifuge. When these flowers cannot be procured fresh they are imported from Spain or Portugal preserved in salt, and yield thus a very fragrant water. Common recipe for orange-flower water.—Take orange flowers fresh and clean, 12 lbs.; water, 40 quarts; salt, 1 lb. Put the water and salt in the still, light the fire, and when near to boiling point infuse the flowers, fix the head and worm, lute, and adapt the Florence receiver, and distil for 20 quarts of eau de fleur d'orange simple. The half, or 10 quarts, for double; the third for triple.

"Rose Water.—Take of fresh rose petals 18 lbs.; water 50 lbs., and distil for 18 lbs. of water. Redistil on fresh roses if you wish a stronger product. Also, good rose water is made from salted rose leaves. To salt the roses, dissolve the salt in boiling water, and then infuse the rose leaves. They will preserve well for six months. Though they become brown, they will not yield less valuable water. Some pack the leaves in dry salt. In like manner are distilled the waters of acacia, lily, and other flowers.

"Citron Water.—Fresh peel of 80 citrons; water, 40 quarts; salt, 1 lb. Distil to 20 quarts. The waters of bergamot and of sweet and bitter oranges are obtained in the same way.

"Apricot Water.—Fresh apricots, 25 lbs.; water, 40 quarts. Distil slowly to 20 quarts. The same preparation applies to waters of prunes, quince, raspberries, and other fruits.

"Water of Marasquin.—Ripe cherries, 40 lbs.; raspberries, fresh and clean, 7 lbs.; leaves of wild cherry, 2½ lbs.; peach nuts, 1 lb.; orrisroot, in powder, 2½ lbs.; water, 40 quarts. Crush the fruit; soak in water 24 hours; distil with care to 20 quarts.

"But it has been stated above that essential oils dissolve in other oils and animal fats. These indeed have so strong an affinity for them that two other processes of their extraction originate in this fact. They are called 'maceration' and 'enfleurage.' Less dignified epithets, but clearer of perception, would be 'soaking' and 'conjunction.'

Flowers are put into liquid fat or into oil, and left till the fat or the oil has absorbed the scent; that is 'maceration.' Or flowers are spread over the expanded surface of oil or solid fat, and left till these substances have possessed themselves of the scent which had belonged to the flowers; that is 'enfleurage.' And by one of these simple processes some of the most exquisite of scents of flowers are procured. Scents of jasmine, heliotrope, violet, cassie, mignonette, tuberose, orange, and even the finest odour of rose, are prepared by one of these processes, or by both these processes; for, after fat has been saturated with scent through flowers soaking in it, the intensity of the saturation may be augmented by spreading over its extended surface, when cold, fresh flowers to yield it their additional perfume. For the maceration process the fat is kept liquid by means of the heat of water at a sufficient temperature surrounding the vessel in which the fat is placed. The French apparatus for this is called 'Bain Marie;' the English ideal of it is a 'gluepot,' in which indeed a mere experiment might safely be made. For the 'enfleurage' process I have

successfully used a common dish, on which purified beef fat was spread to the depth of half an inch. The flowers applied were of jasmine. I present a specimen of the result in the shape of 'essence of jasmine.' The jasmine is a variety known as 'Spanish jasmine' (*Jasminum grandiflorum*). It grows well near Adelaide. I present a specimen both of the plant and of the apparatus for enfleurage by means of either fat or oil, as used at Cannes. Hundreds of these are possessed by some perfumery establishments at Cannes and Grasse. These have been made by Mr. Dodgson, of Hindley-street. The oils used for the maceration of scented plants are neatsfoot and olive oil. The fats are mutton, hogs' lard, and beef fat. The last two are preferred. Both the oils and the fats should be perfectly sweet or inodorous before being used. Their preparation would give quite a distinct trade if the extraction of scents from flowers were carried on extensively and generally. For an experiment, take fresh fat, melt and strain it through a fine hair-sieve into cold spring water, having dissolved in it a little salt and alum.

Repeat this operation three or four times. Then wash the fat five or six times in plain water, and finally remelt and cast it into a pan to free it from adhering water. The scented fats, alone or diluted, constitute the French pomades; or cut up small and soaked for 10 or 12 days in spirits of wine at high proof, and kept at a temperature of 75°, they give the extracts or essences of the perfumer; whilst the scented oils, expressed from the cloths on which they are gathered are the veritable 'Huiles antiques.'

"There is one process for extracting scents from plants yet to be named; it is by evaporation. The invention is recent, and by a French chemist (M. Millon). It consists in dissolving the essential oils in ether, and evaporating them over a gentle fire. The result is a buttery substance, embodying the primitive odour of the plant. This product is said to have the advantage of being absolutely unalterable by exposure to the air, and that it will keep for years in open bottles without losing its properties. If this judgment of it be true, it is fair to conclude that the importance of such a process must be great."

